

PATENT SPECIFICATION

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COMPLETE SPECIFICATION.

Improvements in or relating to Centrifugal Compressors.



We, SIEMENS-SCHUCKERTWERKE AKTIEN-GESELLSCHAFT, a German Company, of Berlin-Siemensstadt, Germany, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

In the regulation of centrifugal compressors as is well known very material difficulties are encountered when the quantity to be fed forward approached the so called pump limit that is to say that condition in which a reversal of the direction of flow takes place in the compressor. Endeavours must be made to keep this pump limit as low as possible so as to enable the compressor to be used within a very wide area of regulation. With the regulation of the speed alone a displacement of the pump limit can not be brought to pass, as, on the contrary additional regulating members will have to be used. According to the present invention these additional regulating members are formed by a change over apparatus by means of which one or more suction stages are switched off or disconnected and, at the same time a corresponding number of pressure stages can be placed in connection. This enables the working area of the compressor to be displaced towards the pressure side where the cross section per se becomes smaller. For the smaller output, consequently, a part of the compressor is utilised which owing to its dimensions is adapted to this quantity.

It is no longer new per se to equip a centrifugal compressor with suction and pressure stages which can be disconnected to enable it to be adapted to changing quantities of supply. However, in the proposals hitherto made quite a different method had been adopted. When the quantity supplied fell off the first suction member and the last pressure member were first disconnected. Upon a further reduction the second suction member and the penultimate pressure member were disconnected and so on. The delivery or supply area of the compressor was, therefore, to a certain extent displaced towards the centre, that is to say in an area in

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which the compressor was bound always to work in a more unfavourable manner. The reason is because the smaller the quantity supplied becomes then, relatively speaking, the greater will the supply cross sections become upon the pressure side, that is to say all the more unfavourable does the method of operation of the compressor become. In contradistinction to this according to the invention the supply range of the compressor is displaced towards the main pressure side that is to say towards those supply cross sections which, owing to their dimensions, are especially adapted to the reduced quantity supplied.

A working example of the invention is shown in the accompanying drawings with three disconnectable suction stages and three disconnectable pressure stages. The suction stages and pressure stages are indicated at 1—3 and 4—6 respectively. The air first flows into the common influx vessel 7 and, after compression, passes into the accumulator 8. In the suction stages there are the clack valves 11—13 and in the pressure stages there are inserted the clack valves 14 to 16. The pivots of the clack valves carry, outside of the condenser, levers 21—26 the levers 21—23 appertaining to the clack valves on the suction side and the levers 24—26 to the valves on the pressure side. These levers co-operate with adjustment rods, the levers 21 and 23 with the rod 9 and the levers 24—26 with the rod 10. For the displacement of the levers 9 and 10 use is made of a lever 19 which is coupled to them through the rod 18. For the displacement of the individual valves the rods 9 and 10 are provided with stops 31 to 36. The lever 21 and the stop 31 and also lever 24 and stop 34 are in engagement with each other through the springs 41 and 44.

The regulating process pursues the following course:—

First with the speed regulator of the driving prime mover its regulating range or area is controlled out. In this case the valves 11 and 14 are opened whilst the remaining valves remain closed. Hence the first three suction stages are in opera-

tion whilst the two last pressure stages are disconnected. The stops 33 and 36 do not bear against the levers 23 and 26. If after regulating out the machine further
 5 controlling ensues the lever 18 is swung out in a clockwise direction by means of the rod 19 so that the rod 10 is displaced to the right and the rod 9 to the left. The valves 11, 12,
 10 14 and 15 upon this movement first pass into the position shown in the drawing. The first suction stage and the ante-penultimate pressure stage are disconnected. Likewise the third suction stage and the
 15 last pressure stage are also disconnected. Should this regulation still be insufficient to adapt the output of the compressor to the reduced consumption then the rod 10 is moved still further and the valves 12
 20 and 15 are also closed whilst at the same time the valves 13 and 16 are opened. The ante-penultimate stage of the compressor now becomes the suction stage and all the other stages of the compressor
 25 participate in the supply. The valves 11 and 14 remain in the position which they had already taken up because the further movement of the rods 9 and 10 only leads to a compression of the loading spring.
 30 If the air consumption again increases then the adjusting process of the individual throttle valves takes place in the opposite direction.

By the new arrangement on the one
 35 hand the pumping limit is very considerably reduced and, on the other hand, the

final pressure is maintained constant which as is well known is primarily dependent upon the number of stages of a compressor.

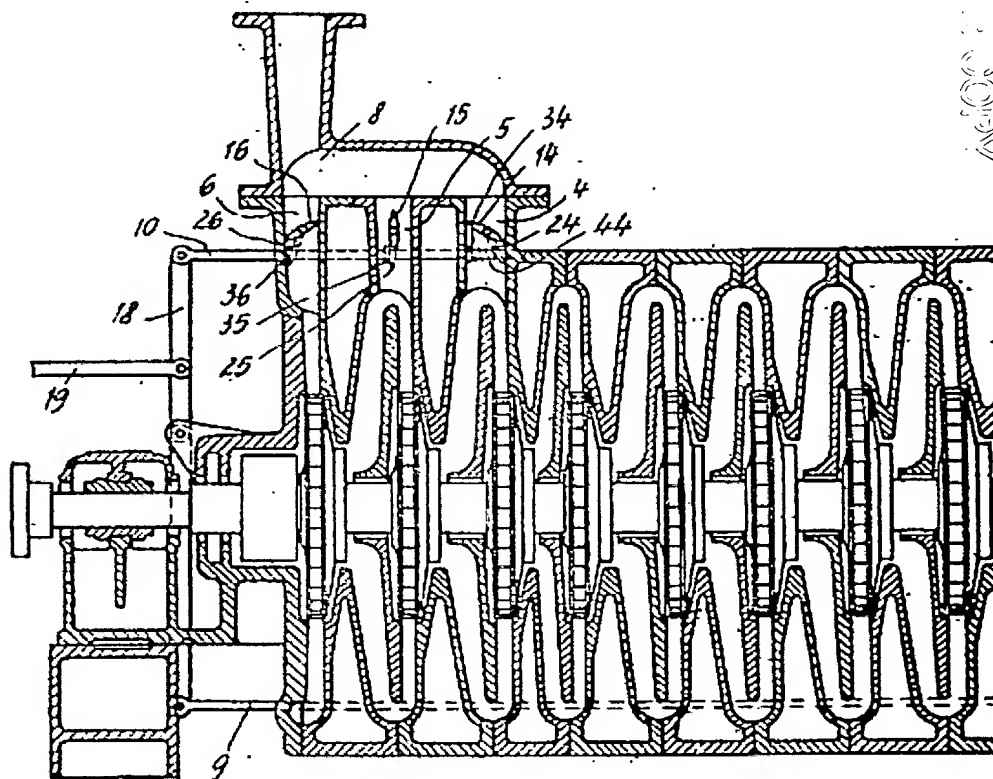
Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

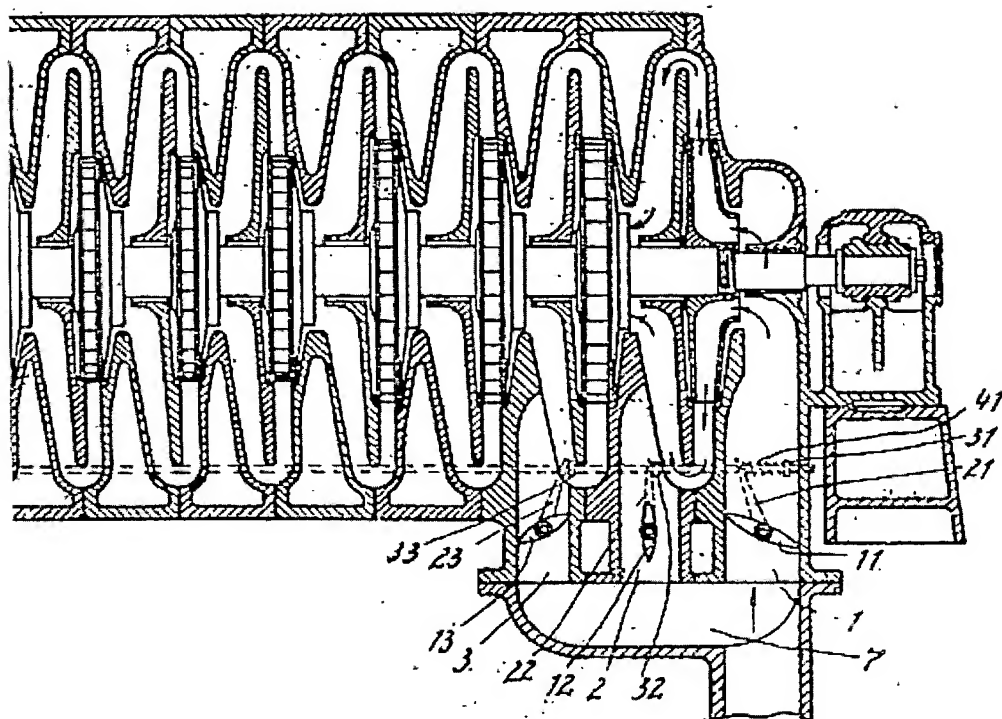
1. An arrangement for reducing the pump limit of centrifugal compressors the cross sections of flow of which become smaller in size towards the pressure side and in which several suction stages and several pressure stages are connected to collecting chambers and in the union pipes change-over members such as clack valves or the like are provided, characterised by the fact that one or more suction stages are adapted to be disconnected whilst at the same time a corresponding number of pressure stages can be so connected that the working range of the compressor is displaced towards the pressure side.

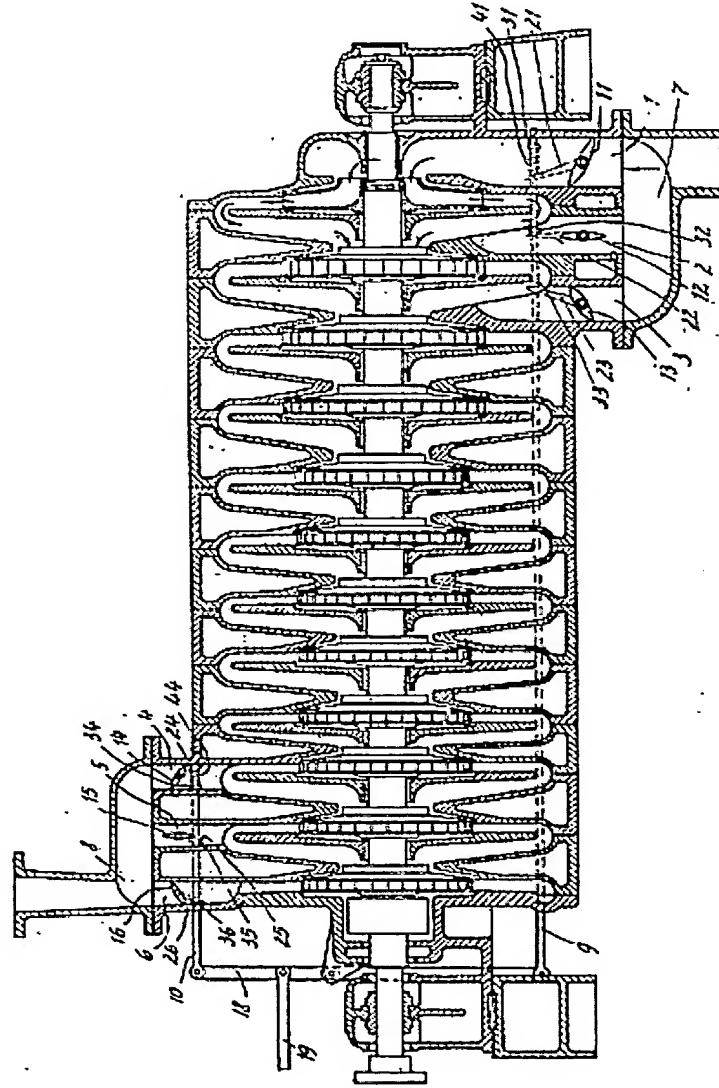
2. A centrifugal compressor constructed and adapted to operate substantially as hereinbefore described with reference to the accompanying drawing.

Dated this 6th day of June, 1930.
 HASELTINE, LAKE & Co.,
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 England, and
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[This Drawing is a full-size reproduction of the Original.]







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